System Would Predictively Preempt Traffic Lights for Emergency Vehicles
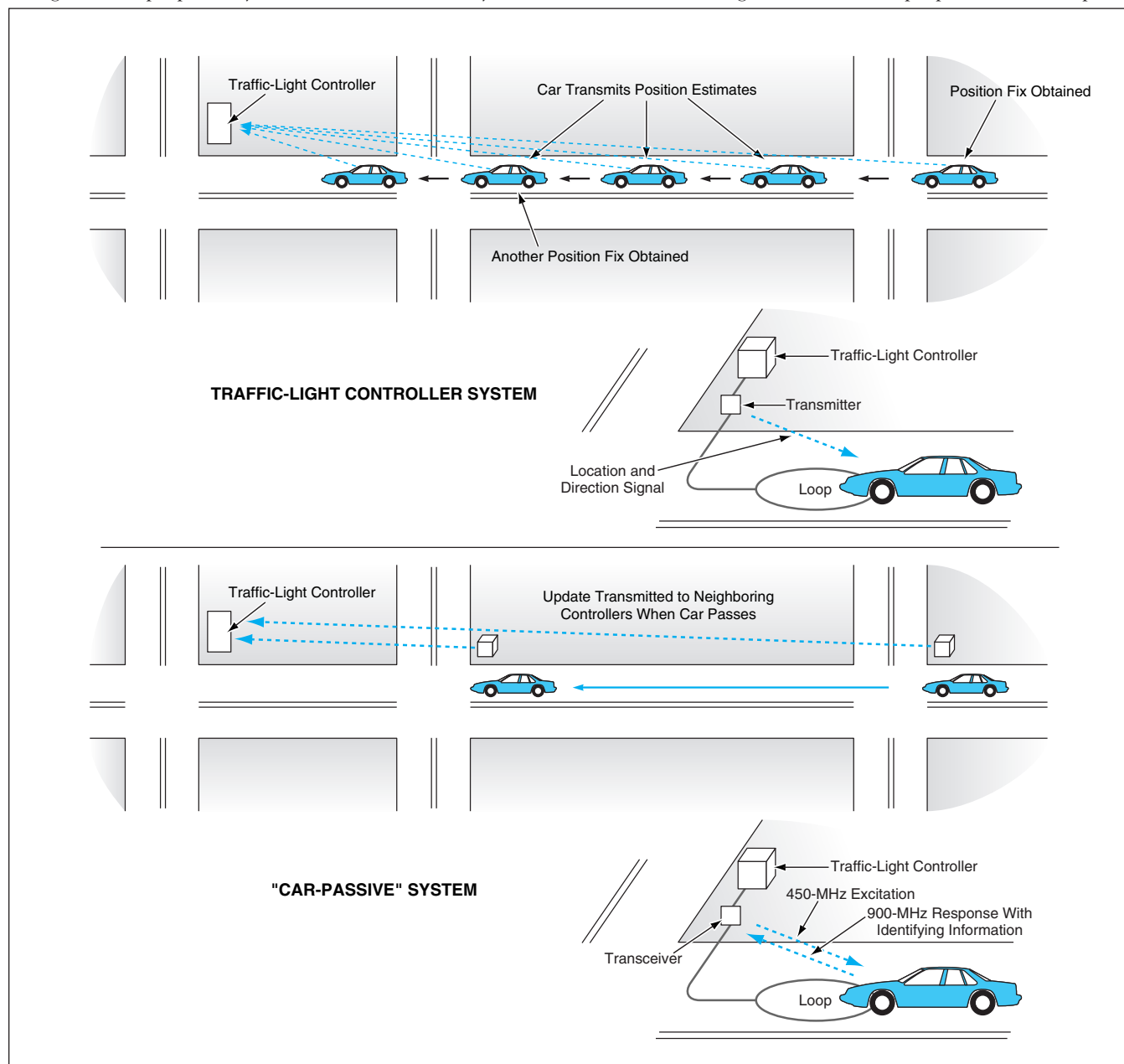
These systems could utilize traffic-light infrastructure already in place.

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Two electronic communication-and-control systems have been proposed as means of modifying the switching of traffic lights to give priority to emergency vehicles. Both systems would utilize the inductive loops already installed in the streets of many municipalities to detect vehicles for timing the switching of traffic lights. The proposed systems could be used alone or to augment other automated emergency traffic-light preemption systems that are already present in some municipalities, including systems that recognize flashing lights or siren sounds or that utilize information on the positions of emergency vehicles derived from the Global Positioning System (GPS). Systems that detect flashing lights and siren sounds are limited in range, cannot "see" or "hear" well around corners, and are highly vulnerable to noise. GPS-based systems are effective in rural areas and small cities, but are often ineffective in large cities because of frequent occultation of GPS satellite signals by large structures. In contrast, the proposed traffic-loop for-

TRAFFIC-LIGHT CONTROLLER SYSTEM

Traffic-Light Controller

Car Transmits Position Estimates

Position Fix Obtained

Another Position Fix Obtained

Traffic-Light Controller

Transmitter

Location and Direction Signal

Loop

"CAR-PASSIVE" SYSTEM

Traffic-Light Controller

Update Transmitted to Neighboring Controllers When Car Passes

Traffic-Light Controller

450-MHz Excitation

900-MHz Response With Identifying Information

Transceiver

Loop

Traffic Lights Would Be Preempted for emergency vehicles by a "car-active" or a "car-passive" system. Both systems would utilize inductive traffic loops already installed in the streets of many municipalities.

ward prediction system would be relatively invulnerable to noise, would not be subject to significant range limitations, and would function well in large cities — even in such places as underneath bridges and in tunnels, where GPS-based systems do not work.

One proposed system has been characterized as "car-active" because each participating emergency vehicle would be equipped with a computer and a radio transceiver that would communicate with stationary transceivers at the traffic loops (see figure). Whenever a vehicle was detected passing over a traffic loop, the loop transceiver, possibly using the loop as an antenna, would transmit a signal identifying the location of the loop and the direction of travel. (Traffic-loop equipment that performs this function is already commercially available.) If the vehicle passing over the loop were a participating vehicle, its transceiver would receive the position signal. The computer in the vehicle would use the signal and the time of its receipt as a time-and-position fix in a continuous "dead reckoning" estimation of the cur-

rent position of the vehicle as function of speed and compass heading. At time intervals of 1 second, the transceiver would broadcast the updated estimate of position to loop receivers at neighboring intersections. The stationary portion of the system would determine, on the basis of the updates, whether the vehicle was likely to pass through a given intersection within a suitable amount of time (typically of the order of 1 minute), in which case the system would preempt the switching of traffic lights at the intersection.

The other proposed system has been characterized as "car-passive" because a passive radio transponder would be installed on the underside of a participating vehicle. When passing over a traffic loop, the transponder would be energized by a signal, at a frequency of 450 MHz, radiated via the loop. When so energized, the transponder would transmit a vehicle identification number signal at a carrier frequency of 900 MHz. Unlike in the car-active system, there would be no continuous estimation of vehicle position. Instead, traffic lights would be

preempted on the basis of simple proximity detection. For this purpose, upon detection of a participating vehicle at a loop at a given intersection, the detection would be signaled to neighboring intersections. Traffic lights at the next intersection or next few intersections through which the vehicle could be expected to pass could then be preempted until the vehicle passed through or until a specified time elapsed.

Optical Position Encoders for High or Low Temperatures
CCD cameras monitor backlit scales via coherent fiber-optic bundles.

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Optoelectronic pattern-recognition systems (optical encoders) for measuring positions of objects of interest at temperatures well below or well above room temperature are undergoing development. At present, the development effort is concentrated on absolute linear, rotary, and Cartesian encoders and Cartesian autocollimators for scientific instruments that operate in cryostats.

Like some prior pattern-recognition optical encoders, a system of the present type includes a backlit scale attached to the object of interest, a charge-coupled-device (CCD) camera, a lens to project a possibly magnified image of the scale onto the CCD, circuitry to digitize the image detected by CCD, and a computer to process the image data to determine positions of the optically projected scale marks in the reference frame embodied in the array of pixels of the CCD. Unlike in prior systems, neither the light source for illuminating the scale nor the CCD is located in the cold or hot environment that contains the object of interest and the attached scale. This arrangement

makes it possible for the CCD to read the scale even though the CCD could not function properly if it were located in that environment. In the case of a cryogenic environment, this arrangement is particularly advantageous because it minimizes spurious heating by the light source and eliminates spurious heating that would otherwise be caused by dissipation of power in the CCD circuitry.

A cryogenic implementation of a linear or rotary encoder of this type is con-
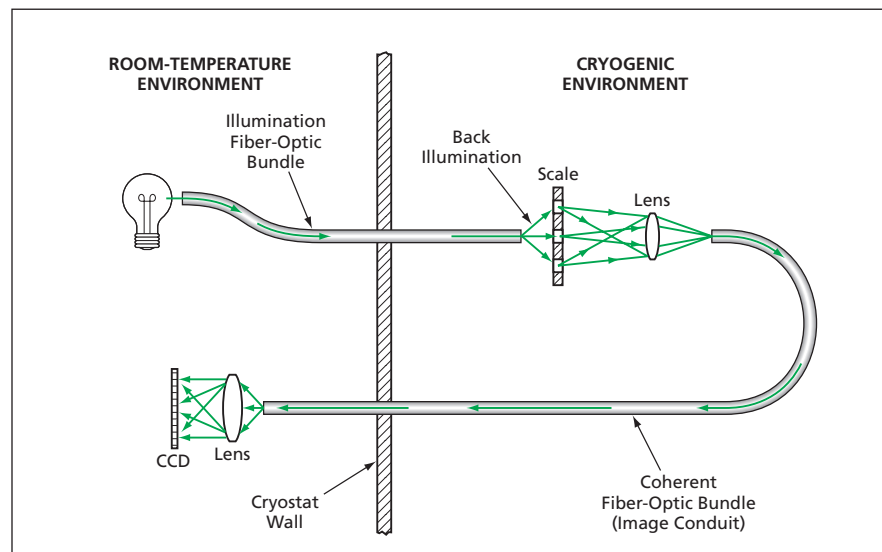
Fiber-Optic Bundles are used to feed light to and from a position-encoding scale in a cryostat.